WHAT IS CLAIMED:

1. A gundrill for forming deep holes in a body of material as the gundrill is relatively rotated, axially advanced and supplied with drilling fluid, the gundrill comprising:

an elongate tubular shank having a driven end, a distal end and a central region extending therebetween along a central axis, the tubular shank having a cross-section defining a shank flute extending from the distal end for at least a substantial portion of the length of the central region, providing a portion of an elongate fluid return path between the hole being drilled and the shank flute, allowing drilling fluid, which is pumped into an internal fluid passage formed through the tubular shank to exit the hole being drilled removing chips as they are formed; and

a cutting tip affixed to the distal end of the tubular shank, the cutting tip having an internal fluid passageway which is coupled to the tubular shank internal passageway and terminates in an orifice formed in a tip end surface, a tip flute extending axially from the tip end surface toward and generally aligned with the shank flute providing a portion of the elongate fluid return path, the tip flute defined by a secondary flank surface and a generally radially extending primary rake surface having a peripheral rake edge lying on a cylindrical surface coaxial with the central axis, and a generally radially extending cutting edge at the tip end which defines a radially offset point;

wherein the surface of the cutting tip circumferentially behind the peripheral rake edge as the gundrill rotates deviates inwardly sufficiently from the cylindrical hole to form an enlarged localized relief

passage which provides an alternative exit path for drilling fluid, the relief passage extending from the tip end toward the tubular shank member.

2. The gundrill of claim 1 wherein the tip end surface of the cutting tip cooperates with the hole being drilled to define a toroidal bottom space area having a portion thereof which lies between the end of the tip and hole bottom forming a pressurized end clearance volume which receives drilling fluid through the tip orifice and discharges drilling fluid through the relief passage and an outlet passage, which is generally bounded by the distal edge of the secondary flank surface and the bottom of the hole being drilled.

3. The gundrill of claim 2 wherein the drilling fluid exiting the outlet passage into the elongate fluid return path initially forms an angle β, relative to the axis of the hole being drilled when viewed radially, which is sufficiently large to effectively cool the tip cutting edge without stagnation.

4. The gundrill of claim 3 wherein the angle β is greater than sixty-six degrees.

5. The gundrill of claim 3 wherein the angle β is greater than seventy-five degrees.

6. The gundrill of claim 3 wherein the area of the outlet passage is sufficiently small so that drilling fluid exit angle β is greater than eighty degrees.

7. The gundrill of claim 2 wherein the cross-sectional area of the outlet passage is less than a longitudinal cross sectional area of the bottom space taken along the hole axis.

8. The gundrill of claim 2 wherein the cross-sectional area of the outlet passage is less than seventy-five percent of a longitudinal cross sectional area of the bottom space taken along the hole axis.

9. The gundrill of claim 2 wherein the cross-sectional area of the outlet passage is less than fifty percent of a longitudinal cross sectional area of the bottom space taken along the hole axis.

10. The gundrill of claim 2 wherein the cross-sectional area of the outlet passage is less than twenty-five percent of a longitudinal cross sectional area of the bottom space taken along the hole axis.

11. The gundrill of claim 2 wherein at least one of the tubular shank and the cutting tip is provided with a crossover port connecting the relief passage to the elongate fluid return path.

12. The gundrill of claim 11 wherein the crossover port is primarily formed in the tubular shank.

13. The gundrill of claim 11 wherein the crossover port is configured to introduce a jet of drilling fluid into the tubular shank passageway at an angle which assists the drilling fluid and entrained chips to exit the hole being drilled.

14. The gundrill of claim 2 wherein the area of the outlet passage is sufficiently small in relation to the area of the relief passage so that over ten percent of the drilling fluid exits the end clearance volume through the relief passage.

15. The gundrill of claim 2 wherein the area of the outlet passage is sufficiently small in relation to the area of the relief passage so that over fifteen percent of the drilling fluid exits the end clearance volume through the relief passage.

16. The gundrill of claim 2 wherein the area of the outlet passage is sufficiently small in relation to the area of the relief passage so that over twenty percent of the drilling fluid exits the end clearance volume through the relief passage.

17. A gundrill for forming deep holes in a body of material as the gundrill is rotated, axially advanced and supplied with drilling fluid, the gundrill comprising:

an elongate tubular shank having a driven end, a distal end and a central region extending therebetween along a central axis, the tubular shank having a cross-section defining a shank flute extending from the distal end for at least a substantial portion of the length of the central region providing a portion of an elongate fluid return path between the hole being drilled and the shank flute allowing drilling fluid, which is pumped into an internal fluid passage formed through the tubular shank to exit the hole being drilled removing chips as they are formed; and

a cutting tip affixed to the distal end of the tubular shank, the cutting tip having an internal fluid passageway which is coupled to the tubular shank internal passage and terminates in an orifice formed in a tip end surface, and a tip flute extending axially from the tip end surface toward and generally aligned with the shank flute providing a portion of the elongate fluid return path, the tip flute defined by a secondary flank surface and a generally radial extending primary rake surface having a peripheral rake edge lying on a cylindrical surface coaxial with the central axis, and a generally radially extending cutting edge at the tip end which defines a radially offset point;

wherein the surface of the cutting tip circumferentially behind the peripheral rake edge as the gundrill rotates deviates inwardly sufficiently from the cylindrical hole to form an enlarged localized relief passage which provides an alternative exit path for drilling fluid extending from the tip end toward the tubular shank member;

wherein the tip end surface of the cutting tip cooperates with the hole being drilled to define a toroidal bottom space area having a portion thereof which lies between the end of the tip and hole bottom forming a pressurized end clearance volume which receives drilling fluid through the tip orifice and discharges drilling fluid through the relief passage and an outlet passage, which is generally bounded by the distal edge of the secondary flank surface and the bottom of the hole being drilled; and

wherein the cross-sectional area of the outlet passage is less than fifty percent of a longitudinal cross-sectional area of the bottom space taken along the hole axis, so that the drilling fluid exiting the outlet passage

into the elongate fluid return path initially forms a maximum angle β, relative to the hole being drilled when viewed radially, which is sufficiently large to effectively cool the tip cutting edge without stagnation.

18. The gundrill of claim 17 wherein the angle β is greater than sixty-six degrees.

19. The gundrill of claim 17 wherein the angle β is greater than seventy-five degrees.

20. The gundrill of claim 17 wherein the area of the outlet passage is sufficiently small in relation to the area of the relief passage so that over ten percent of the drilling fluid exits the end clearance volume through the relief passage.

21. The gundrill of claim 17 wherein the area of the outlet passage is sufficiently small in relation to the area of the relief passage so that over fifteen percent of the drilling fluid exits the end clearance volume through the relief passage.

22. A method of forming a deep hole in a workpiece using a gundrill, the method comprising:

forming a gundrill having an elongate tubular shank having a driven end, a distal end and a central region extending therebetween along a central axis, the tubular shank having a cross-section defining a shank flute extending from the distal end for at least a substantial portion of the length of the central region, providing a portion of an elongate fluid return path between the hole being drilled and the shank flute allowing drilling fluid,

which is pumped into an internal fluid passage formed through the tubular shank, to exit the hole being drilled removing chips as they are formed, and a cutting tip affixed to the distal end of the tubular shank, the cutting tip having an internal fluid passageway, which is coupled to the tubular shank internal passage, which terminates in an orifice formed in a tip end surface and a tip flute extending axially from the tip end surface toward and generally aligned with the shank flute providing a portion of the elongate fluid return path, the tip flute defined by a secondary flank surface and a generally radial extending primary rake surface having a peripheral rake edge lying on a cylindrical surface coaxial with the central axis and a generally radially extending cutting edge at the tip end which defines a radially offset point, wherein the surface of the cutting tip circumferentially behind the peripheral rake edge as the gundrill rotates deviates inwardly sufficiently from the cylindrical hole to form an enlarged localized relief passage which provides an alternative exit path for drilling fluid extending from the tip end toward the tubular shank member; and

supplying the gundrill with drilling fluid while simultaneously rotating and axially advancing the gundrill into the workpiece at the desired hole location wherein the tip end surface of the cutting tip cooperates with the hole being drilled to define a toroidal bottom space area having a portion thereof, which lies between the end of the tip and hole bottom forming a pressurized end clearance volume, which receives drilling fluid through the tip orifice and discharges drilling fluid through the relief passage and an outlet passage, which is generally bounded by the distal edge of the secondary flank surface and the bottom of the hole being drilled, so that the flow of drilling fluid

discharged from the outlet passageway removes chips as they are formed at the hole bottom and removes the chips as the drilling fluid exits the hole through the elongate fluid return path.

23. The method of claim 22 wherein the gundrill is provided with a crossover port connecting the relief passageway to the elongate fluid return path, wherein drilling fluid flowing through the relief passage is introduced into the elongate fluid return path at an angle so as to urge the drilling fluid and entrained chips to exit the hole through the elongate fluid return path.

24. The method of claim 22 wherein the outlet port is sufficiently small relative to the bottom space cross sectional area and the relief passage area to cause at least ten percent of the drilling fluid to exit the pressurized end clearance volume through the relief passage to cool the radially extending cutting edge and peripheral rake edge of the cutting tip.